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1.0 PURPOSE AND SCOPE

(5.1.1)

This standard identifies the climatological conditions of the Hanford Site to be addressed in the design of facilities, systems, structures, and components (SSCs) under the responsibility of the Tank Operations Contractor (TOC) and establishes requirements for winterization/summarization of SSCs to provide protection from expected seasonal changes.

This information applies to any new facility design, existing facility addition and alteration, new equipment, systems and structures supporting facility operation and modification to existing equipment systems and structures in the Hanford 200 Areas, under the responsibility of the TOC.

This standard does not include climatological conditions for use in heating, cooling, ventilating and air conditioning (HVAC) system equipment sizing calculations and design. Use TFC-ENG-STD-07 for the design of new ventilation systems or significant modification of existing ventilation systems.

The technical basis for the requirements in this standard, and approved deviations, can be found in RPP-RPT-28513, "Technical Basis for TFC-ENG-STD-02, Environmental/Seasonal Requirements for TFC Systems, Structures, and Components."

2.0 IMPLEMENTATION

This standard is effective on the date shown in the header. Responsible engineers should review on-going designs to ensure that they meet the requirements of this standard.

NOTE: Deviations to any requirements of this standard shall be requested from the standard document owner. Approved deviations shall be documented in the accompanying Standard Basis Document RPP-RPT-28513.

3.0 STANDARD

3.1 Climatological Conditions

Sections 3.1.1 through 3.1.7 provide key climatological data for the Hanford Site to be used for the design of SSCs within TOC facilities. These data are to be used in conjunction with the design loads required by [TFC-ENG-STD-06](#) to ensure that facilities and SSCs will be compatible with expected Hanford Site environmental conditions. Use TFC-ENG-STD-07 for use in HVAC system equipment sizing or load calculations and system design. The data presented in Sections 3.1.1 through 3.1.7 and corresponding tables are obtained from PNNL-14616, "Hanford Site Climatological Summary 2003 with Historical Data," and HNF-SD-GN-ER-501, "Natural Phenomena Hazards, Hanford Site, Washington." The data presented herein are the key data to be considered in SSC design. More detailed information is provided in PNNL-14616. The outside air temperatures are to be adjusted accordingly for SSCs that are located within buildings and structures, or otherwise insulated. Data is provided for:

- Temperature
- Precipitation
- Winds
- Psychrometric data

**ENVIRONMENTAL/SEASONAL
REQUIREMENTS FOR TOC SYSTEMS,
STRUCTURES, AND COMPONENTS**

- Thunderstorms, dust, and glaze
- Solar radiation
- Atmospheric pressure.

3.1.1 Temperature

Table 1 provides the monthly normal and extremes of daily maximum and minimum temperatures for the period of 1971 through 2003. The highest temperatures are experienced in July and August, with the observed maximum of 113°F for the observation period. The lowest temperatures are experienced in January and February, with the observed minimum of -23°F for the observation period.

Tank Farm SSCs shall be designed for the temperature extremes listed below (HNF-SD-GN-ER-501):

Design Basis Air Temperatures

Performance Category	Maximum (°F)	Minimum (°F)
1	115	-25
2	115	-25
3	115	-25
4	115	-25

Table 2 provides the average daily temperature range by month and year for 1945 through 2003. The monthly average shown in the table is the average of the differences between daily maximum and minimum temperatures each month. The data show that a much greater range of temperatures is experienced in the summer months than in the winter months. Tank Farm SSCs should be designed to withstand a maximum daily temperature range of 50°F (HNF-SD-GN-ER-501).

Subsurface temperature ranges for SSC design for all performance categories are shown in Table 3.

3.1.2 Precipitation

Table 4 shows monthly and annual precipitation totals for the period of 1946 through 2003. Normal monthly precipitation amounts are based on the period of 1971 through 2000 and averages are for the period of record (1946 through 2003). Normal annual precipitation at the Hanford Meteorology Station is 6.98 inches. The wettest year on record was 1995, with 12.31 inches; the driest was 1976, with 2.99 inches. Historically, the months of November through February provide 3.64 inches (52%) of the normal annual precipitation. July and August are the driest months, each normally receiving only 0.27 inches.

Tank Farm SSCs shall be designed for the precipitation loads shown below (HNF-SD-GN-ER-501):

Design Basis Precipitation Loads

Performance Category	Probability	Amount (in.)
1	2×10^{-3}	1.8
2	5×10^{-4}	2.5
3	1×10^{-4}	4.0
4	1×10^{-5}	6.3 (1 mi ²) 5.0 (10 mi ²)

Table 5 provides information on monthly and seasonal snowfall amounts. Snowfall, which includes all frozen precipitation, varies from a seasonal total of 0.3 inches in 1957-1958 to 56.1 inches in 1992-1993. Normal annual snowfall at the Hanford Meteorology Station is 15.4 inches. Tank Farm SSCs shall be designed for the snow loads given in [TFC-ENG-STD-06](#).

3.1.3 Winds

Table 6 provides the monthly and annual prevailing wind direction, average speed, and peak gusts recorded at the Hanford Meteorology Station for the period of 1945 through 2003. The prevailing wind direction for every month of the year is either WNW or NW, and the peak gusts for every month are from the SSW, SW, or WSW. The highest monthly average wind speeds occur in June, the lowest in December. The variability in monthly average wind speeds is much greater in the winter months than during the remainder of the year. Tank Farm SSCs shall be designed for the wind directions above and wind loads given in [TFC-ENG-STD-06](#).

3.1.4 Psychrometric Data

Psychrometric data include observations of dry bulb, wet bulb, dew point temperatures, and relative humidity. Table 7 presents monthly averages and extremes of dry bulb, wet bulb, dew point temperatures, and relative humidity from the Hanford Meteorology Station for the period 1950 through 2003. These variables are collected hourly and are averaged on a monthly (as opposed to a daily) basis. Tank Farm SSCs shall be designed for the humidity ranging from near 0 to 100% (HNF-SD-GN-ER-501).

3.1.5 Thunderstorms, Dust, and Glaze

Table 8 provides data on the number of days of thunderstorms, dust and glaze for the period of 1945 through 2003. Tank Farm SSCs shall be designed for operation under the conditions specified below.

Thunderstorms occurred in every month of the year, except January and November. The thunderstorm season is essentially from April through September. The average number of thunderstorm days per year is 9.8.

The criterion for both dust and blowing dust is that horizontal visibility be reduced to 6 miles or less. Dust is carried into the area from a distant source and may occur without strong winds. Blowing dust occurs when dust is picked up locally and occurs with stronger winds. The average number of days per year with dust or blowing dust is 4.6. The greatest number of such days in

any year was 20 in 1980. The greatest number of days with dust or blowing dust in any month was 9 in May 1980.

Glaze is a coating of ice formed when rain or drizzle freezes on contact with any surface having a temperature that is below freezing. The average number of days with freezing rain or freezing drizzle is 6. The highest number of days with glaze in any winter season was 18 during the winter of 1969-1970; the least, 1 day during the winter of 1987-1988 and earlier winters. The greatest number of such days in any single month was 9 in January 1970.

3.1.6 Solar Radiation

Table 9 presents average and extreme daily solar radiation values (reported in Langleys) by month for the period 1953 through 2003. The highest daily values occur with a clear sky and clean air; the lowest commonly occur on days overcast with low stratus clouds. Tank Farm SSCs shall be capable of operation in a solar radiation environment of 900 Langleys (HNF-SD-GN-ER-501).

3.1.7 Atmospheric Pressure

Table 10 contains atmospheric pressure data for the period of 1955 through 2003. This table lists both station and sea-level pressure (in inches of mercury), including extremes and years of occurrence. The Hanford Meteorology Station pressure is measured at an elevation of 733 feet; sea-level pressure is the station pressure adjusted to sea level. The highest sea-level pressure ever recorded at the Hanford Meteorology Station was 31.12 inches in January 1979; the lowest was 28.91 inches in December 2002. The greatest sea-level pressure change during a 1-day period was 1.02 inches (December 8, 1971). Tank Farm SSCs shall be designed to operate within the extremes listed in Table 10.

3.2 Seasonal (Winterization/Summerization) Requirements

The following facility and equipment-related requirements derive from DOE G 433.1-1, 4.18, "Seasonal/Severe Weather and Adverse Environmental Conditions Maintenance" and operational experience. Seasonal protection measures shall be incorporated into design of new SSCs and modification of existing SSCs where practicable.

For Waste Transfer Pressure Boundary SSCs, one of the following shall apply:

- Documented analysis exists to show there is no potential for freeze damage, or
- Cold weather protection shall be provided. Protection measures shall be based on a documented analysis prepared in accordance with TFC-ENG-DESIGN-C-10, which has been approved by a Mechanical Engineering Discipline Lead.

NOTE: When design conditions or physical configuration are changed, the change must be evaluated and the analysis must be documented.

3.2.1 Cold Weather Protection

- Heating system power and temperature controls are protected against inadvertent deactivation by unauthorized personnel.

**ENVIRONMENTAL/SEASONAL
REQUIREMENTS FOR TOC SYSTEMS,
STRUCTURES, AND COMPONENTS**

- All air intakes, windows, doors, and other access ways that could provide abnormal inflows of cold air are secured. Automatically controlled systems of this type are functionally tested.
- Systems requiring or deserving special protection due to hazards or costs associated with freeze damage have temperature alarms and/or automatic backup heat sources.
- The main water supply cutoffs for each facility are marked and readily accessible to emergency personnel responding to freeze/thaw incident.
- Provide heat traced systems with power indication lights or temperature indication when possible.
- Locate portable heaters away from sensitive instruments, and route the heating circuits separate from instrumentation. The switching of inductive loads in instrumentation cabinets has proven to cause instrumentation errors. The use of direct current heaters, or self regulating heat trace is preferable to AC heaters to reduce noise and interference.
- Heat trace and insulation should be provided to protect against condensation as well as freezing, especially sample lines running from cabinet to cabinet.
- Consider over-sizing the ampacity of supply circuits to self-regulating heat trace. Damp and humid conditions in Hanford valve pits, and the “campaign” approach to many Hanford projects cause these circuits to be left un-energized for long periods of time in damp locations. The initial inrush of current to “dry” these circuits may be considerably in excess of regular wattage needs.

3.2.2 Hot Weather Protection

- Systems that require special protection from extremes of hot weather shall be provided with auxiliary cooling and/or plans exist for their safe shutdown.
- Instrumentation displays and equipment labels that are susceptible to ultraviolet radiation shall be shielded from direct sunlight or placed in a position protected from direct sunlight.
- Cooling system power and temperature controls are protected against inadvertent deactivation by unauthorized personnel.
- Place instrument cabinets on the north side of control trailers or in the shade when possible.
- Provide sunshades over temperature sensitive cabinets to shield displays from direct sunlight, and to minimize the duty cycle of engineered cooling systems.
- Specify cabinets with an air gap between the back of the cabinet and instrument mounting plane. This provides insulation between exterior cabinet surfaces struck by solar radiation and the instruments.

**ENVIRONMENTAL/SEASONAL
REQUIREMENTS FOR TOC SYSTEMS,
STRUCTURES, AND COMPONENTS**

- Specify separate instrument power supplies and repeaters to reduce instrument heat generation. Often devices such as Programmable Logic Controllers and Vector drives include DC power supplies for instrument loops. Use of separate, more hardy DC power supplies, located away from these devices is preferable to minimize the internal heat produced by sensitive microprocessor equipment.
- Minimize the number of intermediate connectors on data buses (such as RS 232 or 485 protocols) connecting field instruments to remote operator control stations. These connections increase network resistance, and therefore heat. Provide network repeaters to minimize strain on sensitive instruments.
- Specify Programmable Logic Controller carriages with extra “slots” and larger power supplies than anticipated for initial service needs. This allows the power supply to be less “taxed,” provides for better heat dispersion, and allows future upgrade capability.

4.0 DEFINITIONS

No terms or phrases unique to this standard are used.

5.0 SOURCES**5.1 Requirements**

1. Management directed.

5.2 References

1. DOE G 433.1-1, 4.18, “Seasonal/Severe Weather and Adverse Environmental Conditions Maintenance.”
2. HNF-SD-GN-ER-501, “Natural Phenomena Hazards, Hanford Site, Washington.”
3. PNNL-14616, “Hanford Site Climatological Summary 2003 with Historical Data.”
4. TFC-ENG-DESIGN-C-10, “Engineering Calculations.”
5. TFC-ENG-STD-06, “Design Loads for Tank Farm Facilities.”
6. TFC-ENG-STD-07, “Ventilation System Design Standard.”

Table 1. Normal and Extreme Monthly Maximum and Minimum Temperature (°F).*

Month	Normal (1971-2003)			Extreme Maximum (1971-2003)				Extreme Minimum (1971-2003)			
	Maximum	Minimum	Mean	High	Date	Low	Date	High	Date	Low	Date
Jan	39	24.7	31.8	72	01/31/71	-2	01/31/50	53	01/30/71	-22	01/26/57
Feb	47.1	28.7	37.9	72	02/25/86	-3	02/01/50	60	02/24/86	-23	02/03/50
				72	02/24/86					-23	02/01/50
Mar	57.8	34.3	46.1	83	03/25/60	24	03/03/60	50	03/15/92	6	03/05/55
								50	03/05/87		
								50	03/03/87		
Apr	66.8	40.2	53.5	94	04/24/77	41	04/07/45	64	04/28/87	21	04/05/75
May	75.7	47.9	61.8	104	05/31/86	51	05/11/67	71	05/29/86	28	05/01/54
				104	05/30/86						
Jun	83.6	55.1	69.3	111	06/23/92	55	06/03/66	80	06/24/92	37	06/03/62
										37	06/02/76
										37	06/01/84
Jul	91.6	61.1	76.3	113	07/13/02	59	07/02/66	82	07/23/94	39	07/02/79
Aug	90.7	60.1	75.4	113	08/04/61	64	08/31/99	81	08/04/61	41	08/22/60
Sep	80.6	51.3	65.9	106	09/01/87	52	09/22/84	72	09/07/55	30	09/27/72
										30	09/25/72
Oct	65.8	40.2	53	89	10/21/03	32	10/30/71	65	10/21/03	7	10/31/02
				89	10/04/80						
				89	10/03/58						
Nov	48.5	31.7	40.1	76	11/13/99	6	11/24/85	60	11/09/89	-13	11/23/85
Dec	38.4	25	31.7	69	12/26/80	-2	12/30/68	56	12/02/75	-14	12/30/68
						-2	12/29/68				
Annual	65.5	41.7	53.6	113	07/13/02	-3	02/01/50	82	07/23/94	-23	02/03/50
				113	08/04/61					-23	02/01/50

*From PNNL-14616.

**ENVIRONMENTAL/SEASONAL
REQUIREMENTS FOR TOC SYSTEMS,
STRUCTURES, AND COMPONENTS**

Table 2. Average Daily Temperature (°F) Range.*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1946	17.3	21	21.8	26.1	29.6	25.6	30.4	29.4	26.8	23.6	17.7	15.8	23.8
1947	18.4	22.2	25.5	27.7	29.6	25.3(a)	29.3	28.8	27.3	18.1(a)	15.4	11.1	23.2
1948	15	17.2	23	23.2	22.6(a)	26.4	29.1	28	28.7	26.5	17.8	15.9	22.8
1949	18.8(a)	19.3	20.6	30.5	28.2	30.2	30.5	30.4	27.2	26.6	16.8	16.7	24.6
1950	16	15.6	20	25.3	29.6	25.7	32.3	31.6	32.4	18.2	14.7	9.7	22.6
1951	13.7	18.4	20.8	30.3	30.2	28.9	33.8(a)	31.5	30.9	23.3	17.4	13.7	24.4
1952	12.6	17	22.8	30.3	28.1	27.3	32.6	32.2	32.8	29	16	9.4	24.2
1953	15.6	19.8	24.4	24	27.9	26.4	32.8	29.1	32.5	27.8	20.3	17.7(a)	24.9
1954	14.3	13.8	23.7	26.3	28.1	26.8	31.4	27.6	26.2	24.5	15.8	13.2	22.6
1955	9.2	18.9	21.8	24.9	25.3	29.4	27.9	31.7	27.5	22.7	16.1	12.3	22.3
1956	12.9	15	20.9	28	26.6	26.9	30.8	28.8	30.6	22.1	13.9	13.4	22.5
1957	15.2	18.3	18.4(a)	24.7	24.8	27.7	28.7	27	29.8	18.4	19.1	14.7	22.2
1958	13.3	15	22	23.9	29.6	27.3	30.5	33.1	27	27.8	17.8	10.2	23.1
1959	14.1	16.2	24.3	26.9	26.5	27.1	31.1	29.9	23.8	24.4	21.9	13.4	23.3
1960	14.6	19.3	23.2	25.7	26.5	31.2	32.8	28.1	28.3	25.7	18.7	10.9	23.8
1961	12.5	17.2	20	25.3	25.5	31.5	30.6	30.9	26.9	25.4	20.4	15	23.4
1962	18.1	17.4	22	28.9	23.2	29.9	30.2	28.3	29.9	21.4	17.3	11.4	23.2
1963	17.2	16.8	23.3	21.4(a)	28.1	26.6	27.8	30.7	29.8	24.5	16.9	9.5	22.7
1964	16	24.1(a)	23.7	27.1	27.9	26.4	31.2	29.4	29.7	26.4	12.2(a)	14.8	24.1
1965	12.3	20.3	25.6	26.4	28.3	28.1	31.1	27.7	29.8	27.4	14.2	15.7	23.9
1966	14.3	19.3	24.4	28.2	30.7	27.3	28.7	29.1	28.4	25.7	18.1	13.4	24
1967	17.6	24	24.6	24.4	27.7	28.7	32	34.5(a)	31.7	25.5	19.9	15.7	25.5(a)
1968	17.2	20.4	23.5	27.5	27.5	27.3	31.2	26.2(a)	28.2	22.8	14.2	13.9	23.3
1969	12.2	14.1	25.5	24.5	29.2	27.7	31.3	33.3	27.6	25	17.4	9.2	23.1
1970	12	16.4	23.8	25.3	29.2	29.3	31.7	33.1	27.2	26.5	17.8	15.4	24
1971	18.4	21.1	22.8	26.8	27.7	26.9	32	32.3	27.8	25.8	17.8	14.8	24.5
1972	17.3	18.3	25.2	26.8	27.2	26.9	30.1	30.6	30.5	27.5	13.1	17.2	24.2
1973	15.7	16.6	24.6	29.6	31.1	29.7	32.1	32.7	27	22.2	12.6	12.5	23.9
1974	17.8	18.8	23.2	23.4	27.3	32.7(a)	29.8	31.9	32.2	28.3	16.3	16.5	24.8
1975	15	17	21.2	24.8	29.5	28.2	30.3	28.7	32.2	22	20.9	14.8	23.7
1976	15.2	21	25.3	26	30.6	28.8	30.5	28	30.5	27.5	20.3	16.6	25
1977	10.8	20.7	23.4	30.6(a)	26	30.2	30.5	29.1	23.8	26.6	19.1	15.1	23.8
1978	11.4	15.2	23	23.8	27.7	31.3	31	29	25.8	30.3(a)	18.2	16.8	23.6
1979	15.5	18.7	26	26.5	29.4	31.1	32.9	32	31.1	25.6	13	12.9	24.6
1980	13.2	10.5(a)	22.1	27.1	25.8	25.8	31.3	29.9	27.3	24.6	15.3	11.4	22.0(a)
1981	9.9	17.5	25.9	27.4	27.1	28.3	31.7	32.9	30.8	26	20	14.2	24.3
1982	16	21.4	24.4	28.2	29.9	28	30.6	29.5	27.1	24.9	16.6	13	24.1
1983	15.5	17.3	20.7	27.9	28.4	27.9	26.3	28.4	27.5	24.7	15.5	11	22.6
1984	13.5	15.2	21.6	23.9	26.3	26.1	32.3	32	26.6	25.5	14	15.7	22.7
1985	6.8(a)	20.4	25.4	28.7	29.2	29.4	32	29.9	24.3	25.4	15.8	8.0(a)	22.9
1986	12.5	17.1	22.1	26.4	26.6	29.1	28.6	31	23.5(a)	26.8	15.1	8.4	22.3
1987	11.9	19	22.4	28.2	28.9	31.2	28.1	30.1	33	28.9	19.8	12	24.5
1988	13.4	23.8	25.1	25.3	27.4	26.3	30	32.1	31.2	26.2	16.9	11.4	24.1
1989	16.5	17.3	20.2	26.2	26	28.5	31.1	27.3	31.1	24	16	9.4	22.8
1990	15.7	20.5	26.5	27.1	24.4	26.8	28.8	27.3	32.2	23.6	18.4	16	23.9
1991	16	21.4	22.7	26	25.1	25.6	30.2	29.6	31.1	26.4	13.1	13.5	23.4
1992	12.5	15.2	25.9	24.6	31.9(a)	28.5	28	31.6	28.1	24.4	13.6	14.5	23.2
1993	12.8	15.1	18.6	23.7	29.1	27.1	25.5(a)	29.5	33.5(a)	28.6	23.9(a)	10.5	23.2
1994	15.7	17.2	28.4(a)	26	26.5	29.4	33	31.2	31.2	25.4	17.2	13.6	24.6

*From PNNL-14616.

**ENVIRONMENTAL/SEASONAL
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Table 2. Average Daily Temperature (°F) Range.* (cont.)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1995	13.2	20.1	23.7	25.2	28	26.3	29.9	30.6	30.2	24.3	19.5	11.7	23.6
1996	14	21.2	22.9	26	26.6	31	33.7	34.1	30.8	23.9	17	13.1	24.5
1997	15.6	18.8	22.1	25.7	28.1	27.3	31.2	31.2	26.7	24.3	17.6	14.2	23.6
1998	15.9	19	23.7	28.5	27.5	29.2	30.5	33.2	31.9	26.6	16.2	17.7(a)	25
1999	16.4	18	22.2	28.9	28	28	30.2	29	32.9	25.7	17.7	13.5	24.2
2000	14	16.8	23.3	28.2	26.4	29	31.9	32.7	27.9	23.5	14.1	9.1	23.1
2001	10.5	17.7	24.3	24.2	30.6	26.7	29.5	31.4	31	23.8	16.2	13.4	23.3
2002	15.3	22.4	22.5	26.9	26.8	28.8	32.1	29.8	30.9	29.9	19.2	8.9	24.3
2003	10.5	20.8	23.3	24.2	26.6	30.2	34.3	31.5	30.5	27.2	21.3	11.6	24.3
Average(b)	14.4	18.3	23.1	26.4	27.7	28.1	30.6	30.3	29.1	25.1	16.9	13.3	23.6
Normal	14.3	18.3	23.5	26.6	27.8	28.5	30.5	30.6	29.3	25.6	16.8	13.3	23.8

*From PNNL-14616.

(a) Greatest and least values.

(b) Based on entire period of record, 1945 through 2003.

Table 3. Subsurface Soil Temperature (°F) at Depths of .05, 15, and 36 Inches.*

Month	Monthly Averages			0.5-in. Depth				15-in. Depth				36-in. Depth			
	0.5 in.	15 in.	36 in.	Highest Monthly		Lowest Monthly		Highest Monthly		Lowest Monthly		Highest Monthly		Lowest Monthly	
				Average	Year	Average	Year	Average	Year	Average	Year	Average	Year	Average	Year
Jan	32.8	36.3	42.7	39.4	1967	19.2	1979	42.7	1981	25.5	1979	48.7	1975	36.3	1979
Feb	38.3	38.9	42	45.1	1958	28.6	1989	44.9	1967	29.6	1957	46.9	1967	33.5	1957
Mar	48.1	46.4	46.1	54.3	1992	42.4	1955	52.6	1968	37.7	1956	51.7	1968	38	1956
Apr	59.8	55.7	53.1	69.4	1977	52.4	1984	62.1	1977	48.7	1955	57.4	1966	47.3	1955
May	72	65.5	60.7	81.4	1992	63.6	1984	71.4	1992	58.7	1984	65.1	1987	54.8	1955
Jun	82.6	75.1	68.6	90.4	1986	75.3	1956	84.5	1966	70.2	1956	73.4	1969	62.8	1984
Jul	90.9	81.8	75.1	96.2	1973	81	1993	88.2	1967	75.4	1955	81.1	1967	70.8	1955
Aug	87.6	82.8	78.5	94.9	1971	81.6	1960	89.2	1967	77.5	1964	83.9	1967	75.3	1999(a)
Sep	74	74.7	74.9	81	1967	65.5	1985	82.2	1967	68.8	1959	81.4	1967	70.1	1978
Oct	56.5	62.5	67.3	62.6	1988	52.4	1985	67	2003	57.9	1957	72.3	1967	62.9	1959
Nov	40.7	48.1	56.8	45.7	1999	31.9	1985	54	1974	42.5	1955	62.7	1974	51.2	1955
Dec	33.5	39.1	47.8	38.7	1974	26.5	1984	45	1974	34.1	1984	54.6	1974	41.4	1955
Annual	59.7	58.9	59.6	62.8	1967	55.9	1955	63	1967	54.6	1955	67.3	1987	55.5	1955
Absolute Hourly Extremes															
	156.8	1996	-2	1972	93	1967	16.1	1979	85.3	1967	32.2	1957			

(a) Most recent of multiple occurrences.

*From PNNL-14616.

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Table 4. Monthly and Annual Precipitation (inches).*

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1946	--	--	--	--	--	--	0.15	0.35	0.52	0.65	0.66	0.11	--
1947	0.32	0.27	0.42	0.7	0.02	1.07	0.71	0.68	1.34(a)	2.2	0.81	0.75	9.29
1948	1.36	0.69	0.07	0.95	1.71	1.47	0.4	0.39	0.16	0.45	0.95	1.11	9.71
1949	0.13	0.68	1.12	0.02	0.16	0.01	0.01	0.03	0.23	0.1	1.47	0.16	4.12
1950	1.8	1.06	0.87	0.47	0.27	2.92(a)	0.07	T	0.01	2.46	0.55	0.97	11.45
1951	0.84	0.51	0.46	0.53	0.43	1.38	0.37	0.15	0.1	0.71	0.82	0.7	7
1952	0.65	0.5	0.06	0.13	0.58	1.07	T	0.08	0.08	0.04	0.2	0.77	4.16
1953	2.16	0.25	0.17	0.77	0.28	0.55	T	0.96	0.13	0.2	0.96	0.49	6.92
1954	1.48	0.28	0.59	0.07	0.41	0.1	0.22	0.42	0.51	0.42	0.86	0.35	5.71
1955	0.56	0.22	0.17	0.4	0.59	0.28	0.57	0	0.77	0.4	1.54	2.03	7.53
1956	1.71	0.56	0.1	T	0.22	0.86	T	0.38	0.01	1.03	0.15	0.58	5.6
1957	0.48	0.23	1.86(a)	0.38	0.82	0.47	0.05	0.02	0.34	2.72(a)	0.39	0.53	8.29
1958	1.74	1.48	0.46	0.64	0.74	0.81	0.02	T	0.05	0.19	0.77	1.84	8.74
1959	2.05	1.17	0.4	0.2	0.5	0.23	T	0.03	1.26	0.56	0.41	0.26	7.07
1960	0.51	0.58	0.67	0.53	0.71	0.14	T	0.26	0.23	0.23	0.92	0.64	5.42
1961	0.33	2.10(a)	1.02	0.48	0.8	0.42	0.15	0.09	T	0.07	0.49	0.89	6.84
1962	0.13	0.9	0.14	0.34	1.35	0.12	T	0.5	0.38	0.95	0.65	0.6	6.06
1963	0.95	0.69	0.53	1.17	0.43	0.28	0.31	0.01	0.02	0.04	0.74	1.14	6.31
1964	0.37	0.01	0.03	0.11	0.04	0.9	0.04	0.24	0.09	0.28	0.94	2.34	5.39
1965	0.93	0.14	0.03	0.09	0.15	0.49	0.11	0.03	0.11	0.01	1.17	0.39	3.65
1966	0.68	0.03	0.39	0.03	0.05	0.43	0.81	T	0.27	0.39	2.25	0.6	5.93
1967	0.32	T	0.14	0.9	0.56	0.57	T	T	0.05	0.13	0.16	0.43	3.26
1968	0.88	0.58	0.02(a)	0.01	0.06	0.19	0.04	0.51	0.25	0.93	1.23	1.25	5.95
1969	1.24	0.54	0.1	1.22	0.51	0.75	T	T	0.48	0.1	0.13	1.29	6.36
1970	2.47(a)	0.75	0.27	0.45	0.54	0.25	0.01	T	0.03	0.24	0.71	0.61	6.33
1971	0.78	0.1	1.02	0.07	0.56	0.71	0.13	0.09	1.13	0.18	0.46	1.07	6.3
1972	0.19	0.27	0.58	0.1	2.03(a)	0.66	0.16	0.56	0.02	T	0.55	1.27	6.39
1973	0.9	0.21	0.08	T	0.24	0.01	T	0.02	0.43	1.72	2.64	2.02	8.27
1974	0.9	0.41	0.52	0.46	0.28	0.12	0.71	T	0.01	0.21	0.71	0.97	5.3
1975	1.43	0.98	0.33	0.42	0.38	0.24	0.32	1.16	0.03	0.87	0.6	0.7	7.46
1976	0.56	0.36	0.23	0.41	0.08	0.11	0.13	0.96	T	0.04	T(a)	0.11(a,b)	2.99(a)
1977	0.08(a)	0.57	0.41	T	0.65	0.37	0.06	1.36(a)	0.66	0.15	0.63	1.47	6.41
1978	1.72	0.92	0.3	0.46	0.41	0.09	0.52	0.57	0.11	T	1.21	0.26	6.57
1979	0.54	0.17	0.54	0.52	0.1	T	0.09	0.38	0.2	0.67	1.36	0.99	5.56
1980	1.32	1.3	0.3	0.86	1.41	0.96	T	0.02	0.85	0.33	0.44	1.89	9.68
1981	0.56	0.6	0.7	0.02	0.99	0.43	0.19	0.03	0.6	0.39	1.08	1.45	7.04
1982	0.33	0.57	0.3	0.75	0.28	0.75	0.22	0.2	0.55	1.33	0.91	1.79	7.98
1983	1.44	1.36	1	0.42	0.52	0.68	0.31	0.12	0.46	0.52	2.12	2.12	11.07
1984	0.23	0.94	1.01	0.6	0.55	0.99	0.06	T	0.42	0.07	1.83	0.57	7.27
1985	0.34	0.82	0.36	0.01	0.12	0.15	0.12	0.01	0.63	0.46	1.24	0.84	5.1
1986	1.76	1.37	0.76	T	0.3	T	0.21	0.02	0.96	0.29	0.65	0.77	7.09

*From PNNL-14616.

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Table 4. Monthly and Annual Precipitation (inches).* (cont.)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1987	0.8	0.19	1.05	0.14	0.17	0.11	0.5	0.07	0.01	T(a,b)	0.4	1.63	5.07
1988	0.48	T(a,b)	0.39	1.12	0.33	0.11	0.13	0(a,b)	0.39	0.01	0.82	0.4	4.18
1989	0.21	1.67	1.56	0.84	0.59	0.01	0.01	0.26	0.02	0.42	1.04	0.29	6.92
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1990	0.77	0.09	0.1	0.4	0.86	0.36	0.14	0.83	T	0.78	0.02	0.72	5.07
1991	0.33	0.19	1.12	0.45	0.49	1.44	0.29	0.07	0	0.53	1.44	0.4	6.75
1992	0.44	0.94	0.09	0.94	T(a)	1.14	0.38	0.2	0.27	0.61	1.07	1.82	7.9
1993	1.3	1.17	0.67	0.71	0.6	0.12	1.76(a)	0.24	0.04	0.09	0.19	0.94	7.83
1994	0.44	0.11	0.03	0.61	1.27	0.38	0.15	0.08	0.08	0.93	0.68	1.36	6.12
1995	2.14	0.69	0.95	1.54	0.79	0.77	0.34	0.07	0.79	0.87	1.04	2.32	12.31(a)
1996	1.42	1.22	0.83	0.43	0.62	0.05	0.14	0.02	0.22	0.88	2.67(a)	3.69(a)	12.19
1997	1.51	0.25	0.7	0.33	0.33	0.46	0.19	0.06	0.32	0.92	1.01	0.31	6.39
1998	1.24	1.15	0.5	0.07	0.52	0.48	0.34	0.04	0.1	0.28	1.29	0.44	6.45
1999	0.89	0.7	0.06	T(a,b)	0.34	0.31	0.07	0.57	0(a,b)	0.48	0.26	0.07	3.75
2000	1.09	1.12	0.94	0.57	0.77	0.25	0.46	T	0.56	0.57	1.08	0.67	8.08
2001	0.29	0.42	0.67	0.83	0.08	1.27	0.05	0.08	0.13	0.37	1.67	0.8	6.66
2002	0.42	0.67	0.19	0.29	0.16	0.65	0.16	0.01	T	0.12	0.38	2.26	5.41
2003	1.87	0.82	0.26	2.23(a)	0.08	T(a,b)	0(a)	0.46	0.24	0.07	0.15	1.96	8.14
Average(c)	0.93	0.64	0.5	0.48	0.51	0.53	0.21	0.23	0.3	0.53	0.89	1.04	6.79
Normal	0.87	0.68	0.58	0.44	0.55	0.41	0.27	0.27	0.33	0.49	0.98	1.11	6.98

*From PNNL-14616.

(a) Greatest and least values.

(b) Most recent of multiple occurrences.

(c) Based on the entire period of record, 1946 through 2003.

NOTE: Dashes indicate no data are available.

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Table 5. Monthly and Seasonal Snowfall (inches).*

Season	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total
1945-1946	--	--	--	--	--	--	--	--
1946-1947	T	7.2	0.5	3.3	T	T	0	11
1947-1948	0	T	3	2.6	5.5	0.1	T	11.2
1948-1949	0	1.7	8.1	1.8	6.9	T	0	18.5
1949-1950	T	0	0.7	23.4(a)	3.1	1.5	T	28.7
1950-1951	0	0.8	2.9	5.3	5.3	4.2(a)	0	18.5
1951-1952	0	0.5	4.4	7.5	3.1	T	0	15.5
1952-1953	0	T	3.1	2.7	0	T	0	5.8
1953-1954	0	0	1	14.3	1.6	T	0	16.9
1954-1955	0	0	1.8	6	2.4	0.7	T	10.9
1955-1956	0	12.7	13.4	10.2	2.2	T	0	38.5
1956-1957	T	0.1	2.5	7.9	1.4	4	T	15.9
1957-1958	0.3	0	T	T	0	T	0	0.3(a)
1958-1959	0	T	0.9	4.5	12.7	0	0	18.1
1959-1960	0	0.3	1	5.9	T	1.5	0	8.7
1960-1961	0	0	3.3	1.9	0	1.6	0	6.8
1961-1962	0	0.5	6.1	0.4	2.4	0.9	0	10.3
1962-1963	0	T	T(a,b)	7.1	0.6	0	0	7.7
1963-1964	0	T	6.4	2.9	T	T	T	9.3
1964-1965	0	0.1	19.1	6.6	T	T	0	25.8
1965-1966	0	T	6.9	2.6	T	T	0	9.5
1966-1967	0	0.4	2.8	0.1	0	0	0	3.3
1967-1968	0	0	5.7	4.5	0.3	0	T	10.5
1968-1969	0	T	9.7	15.9	2.1	0	0	27.7
1969-1970	0	T	2.7	6.6	T	0.2	0	9.5
1970-1971	0	0.5	4.4	2	T	0.6	0	7.5
1971-1972	0.6	T	8.1	4.9	1.4	0.1	T	15.1
1972-1973	0	T	7.2	4.3	1.7	0	0	13.2
1973-1974	1.5(a)	6.6	7.5	3.9	0	T	0	19.5
1974-1975	0	0	0.7	2.5	12.1	T	T	15.3
1975-1976	0	1.7	3.8	6	0.2	T	T	11.7
1976-1977	0	0	0.2	2.9	T	T	0	3.1
1977-1978	0	2.1	3.4	2.9	0.9	T	0	9.3
1978-1979	0	10.1	1.4	10.3	0.5	0.1	0	22.6
1979-1980	0	5.6	7.3	8.7	4.5	0.3	0	26.2
1980-1981	0	0.3	2.2	T	T	0	0	2.5
1981-1982	0	0	12.1	2.4	T	T	1.0(a)	15.5
1982-1983	0	0.2	4.6	3.2	2.3	0	0	10.3
1983-1984	0	T	17.8	1.5	T	0	0	19.3
1984-1985	T	4.9	5.8	1.3	8.5	1.4	0	21.9
1985-1986	0	18.3(a)	7.6	2.7	5.5	0	0	34.1

Note: *From PNNL-14616.

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Table 5. Monthly and Seasonal Snowfall (inches).* (cont.)

Season	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total
1986-1987	0	0	5.1	3.3	0	0	0	8.4
1987-1988	0	1.1	4.7	5.6	0	0	0.2	11.6
1988-1989	0	0	3.5	0.2	17.0(a)	3.1	T	23.8
1989-1990	0	0	1.4	0.6	0.7	T	0	2.7
1990-1991	0	0	6.1	3.8	0	0.1	0	10
1991-1992	1.2	T	0.6	0.3	T	0	0	2.1
1992-1993	0	2.1	21	17.1	12.4	3.5	0	56.1(a)
1993-1994	0	1.4	1.8	0(a)	0.9	0	0	4.1
1994-1995	0	0.1	4.2	2.7	T	0	T	7
1995-1996	0	1	4	16.7	5.9	0.4	0	28
1996-1997	0	11.9	22.6(a)	1.8	2.7	1.5	0	40.5
1997-1998	0	0	1.8	6.3	T	T	0	8.1
1998-1999	0	0	0.9	T	T	0	0	0.9
1999-2000	0	0	0.6	8.2	0.5	0	0	9.3
2000-2001	0	1.2	6.6	2.3	4.3	0	0	14.4
2001-2002	0	5	3.5	0.6	0.2	1.4	0	2.8
2002-2003	0	T	0.6	0.7	0(a,b)	0(a,b)	0(a,b)	1.3
2003-2004	0(a,b)	0(a,b)	8	--	--	--	--	--
Average(c)	0.1	1.7	5.1	4.8	2.3	0.5	T	14.5
Normal	0.1	2.3	5.8	4.2	2.6	0.4	T	15.4

Note: *From PNNL-14616.

(a) Greatest and least values.

(b) Most recent of multiple occurrences.

(c) Based on entire period of record, 1946 through 2003.

T = Trace.

NOTE: Dashes indicate no data are available.

Table 6. Monthly and Annual Prevailing Wind Direction, Average Speed, and Peak Gusts.*

Month	Prevailing Direction	Average Speed (mph)	Highest Average		Lowest Average		Peak Gusts		
			mph	year	mph	year	mph	Direction	Year
Jan	NW	6.3	10.3	1972	2.9	1985	80	SW	1972
Feb	NW	7.1	11.1	1999	4.6	1963	65	SW	1971
Mar	WNW	8.2	10.7	1977(a)	5.9	1958	70	SW	1956
Apr	WNW	8.8	11.1	1972(a)	7.4	1989(a)	73	SSW	1972
May	WNW	8.8	10.7	1983	5.8	1957	71	SSW	1948
Jun	NW	9.1	10.7	1983(a)	7.7	1950(a)	72	SW	1957
Jul	NW	8.6	10.7	1983	6.8	1955	69	WSW	1979
Aug	WNW	8	9.5	1996	6	1956	66	SW	1961
Sep	WNW	7.5	9.2	1961	5.4	1957	65	SSW	1953
Oct	NW	6.6	9.1	1946	4.4	1952	72	SW	1997
Nov	NW	6.4	10	1990	2.9	1956	67	WSW	1993
Dec	NW	6	8.3	1968	3.3	1985	71	SW	1955
Annual	NW	7.6	8.8	1999	6.2	1989	80	SW	1972

Note: *From PNNL-14616.

(a) Also in earlier years

Table 7. Monthly Averages and Extremes of Psychrometric Data, 1950 through 2003.*

Monthly Averages													
Category(a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Dry bulb	31.4	37.6	45.2	53.2	62.1	69.9	77.3	75.7	66.5	53	40.1	32.6	53.7
Wet bulb	29	34	39	44	50	55	58	58	53	45	37	31	44
Rel. hum.	77.5	70.4	56.6	47.5	42.9	39.5	33.3	35.6	42.1	56.1	73.6	80.4	54.6
Dew point	24.8	27.8	29	31.8	37	41.6	43.8	44.1	40.4	36	31.5	26.7	34.5
Extremes of Monthly Averages, Dry Bulb Temperature (°F)													
Highest	43	44.6	51.6	58.6	68.7	77.3	83.3	82.5	72.7	59.5	46.4	38.8	56.6
Year	1953	1991	1992	1987	1958	1992	1985	1967	1990	1988	1999	1953	1992
Lowest	12.9	25.8	39.6	48.3	57	64.2	71.3	70.6	58.9	48.1	25.7	21.9	50.2
Year	1950	1956	1955	1955	1984	1953	1986	1964	1985	1984	1985	1985	1985
Extremes of Monthly Averages, Wet Bulb Temperature (°F)													
Highest	39	41	44	47	55	59	63	61	56	50	42	36	47
Year	1953	1956	1992	1992	1958	1992(b)	1998	1999(b)	1995(b)	1988	1999(b)	1991(b)	1992
Lowest	12	23	33	39	45	51	56	55	48	40	24	21	41
Year	1950	1956	1955	1955	1959	1983(b)	1986(b)	1980(b)	1970	1984	1978	1985(b)	1985
Extremes of Monthly Averages, Relative Humidity (%)													
Highest	88.8	86.9	69.1	64.5	61.9	53.5	45.6	47.8	55.5	74.2	88.7	90.5	58.9
Year	1960	1963	1993	1963	1948	1950	1993	1976	1977	1962	1979	1950	1978
Lowest	60	54	44	36.9	31.2	30	21.9	24.5	33.2	42.5	62.8	69	49.4
Year	1963	1967	1965	1966	1966	1949	1959	1967	1974	1952	1976	1968	1967
Extremes of Monthly Averages, Dew Point (°F)													
Highest	34.4	36.7	37.2	37.1	43.9	47.5	50.1	48.4	45.4	43.5	38.3	34.3	37.7
Year	1953	1992(b)	1986	1992(b)	1998	1958	1975	1976	1963	1962	1954	1950	1958
Lowest	6.5	17.3	20.8	26	30.4	37.5	35.4	38.4	33.8	30.2	19.4	15.1	31.5
Year	1950	1956	1965(b)	1982	1964	1954	1959	1955	1970	1984	1985	1983	1955

*From PNNL-14616.

(a) Dry bulb, wet bulb, and dew point temperatures in °F, relative humidity in %.

(b) Most recent of multiple occurrences.

Table 8. Average Number of Days of Thunderstorms, Dust and Glaze, 1945 through 2003.*

Phenomenon	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Thunderstorm	0	≤0.1	0.2	0.8	1.5	2.2	2.2	2	0.7	0.2	0	≤0.1	9.8
Dust or blowing dust	0.4	0.4	0.5	0.6	0.6	0.4	0.4	0.2	0.5	0.3	0.2	0.2	4.6
Glaze	2	0.6	≤0.1	0	0	0	0	0	0	0	0.8	2.4	6

*From PNNL-14616.

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Table 9. Average and Extreme Solar Radiation Daily Values (Langley), 1953 through 2003.*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average	105	185	317	446	546	604	628	535	402	252	123	82	352
Highest	277	422	542	704	838	821	808	721	591	434	295	196	838
Year	1969	1958	1968	1972	1977	1971	1974	1957	1970	1973	1971	1972	1977
Lowest	16	11	44	75	67	92	118	82	61	33	13	6	6
Year	1976(a)	1995	1979	1974	1962	1992	1972	2003	1957	1974	2001	2002	2002

*From PNNL-14616.

(a) Most recent of multiple occurrences.

Table 10. Average and Extreme Station and Sea-Level Pressure Data, 1955 through 2003 (inches of mercury).*

Month	Hanford Meteorology Station						Sea-Level			
	Average	High	Year	Low	Year	Max Daily Range	High	Year	Low	Year
Jan	29.32	30.23	1979(a)	28.18	1980	0.77	31.12	1979	28.94	1964
Feb	29.27	30.08	1956	28.23	1958(a)	0.86	30.97	1956(a)	28.98	1958(a)
Mar	29.2	29.92	1955	28.34	1995	0.85	30.79	1955	29.11	1995
Apr	29.19	29.91	1999	28.49	1962(a)	0.81	30.73	1999	29.26	1962
May	29.16	29.72	2003	28.61	1999	0.47	30.53	2003	29.38	1999(a)
Jun	29.14	29.6	1987(a)	28.67	1992(a)	0.54	30.4	1987	29.42	1992
Jul	29.14	29.56	1993(a)	28.8	2002(a)	0.48	30.34	1993(a)	29.55	2002(a)
Aug	29.14	29.55	1968	28.75	1980	0.39	30.32	1968	29.52	1980
Sep	29.18	29.79	1983(a)	28.48	1986(a)	0.56	30.6	1983	29.25	1986
Oct	29.25	29.86	1999	28.39	1962	0.74	30.68	1999(a)	29.15	1962
Nov	29.28	30.06	1979(a)	28.36	2002(a)	0.78	30.9	1979(a)	29.13	2002(a)
Dec	29.32	30.2	1978	28.15	2002	1.02	31.07	1978(a)	28.91	2002
Annual	29.22	30.23	1979(a)	28.15	2002	1.02	31.12	1979	28.91	2002

*From PNNL-14616.

(a) Most recent of several occurrences.